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DATA ON LESSER-KNOWN COAL DEPOSITS

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Pechora Basin

The Pechora Basin covers the basin of the Pechora River, located between the North Urals on the east and the Timanskiy Ridge on the West. The coal-bearing properties of the territory were known at the end of the last century. The first steps toward studying them were undertaken at the beginning of the 20th Century, but detailed exploration and exploitation of the Pechora Basin were started only after the October Revolution.

A considerable part of the Pechora Basin is located beyond the Arctic Circle. This explains its physical-geographical peculiarities.

The contour in the central part of the basin is slightly dotted with hills. The west and, particularly, the east have a rather highly broken up character. The river network consists of the Pechora River and its numerous tributaries. The main area of the basin is located in the permafrost zone.

According to published data, the coal-bearing properties of the basin have been studied only in specific regions. Among these are Vorkuta, Adz'-vinskiy, Into-Kozhimskiy, Nechensko-Fleshshorskiy, and Zaostrensko-Shar'inskiy. Of all these coal-bearing regions, the best known is Vorkuta, located in the basin of the Vorkuta River. Here 11 coal seams are known, with thicknesses ranging from 0.5 to 3.8 meters. The thickness of the seams is not sustained along the strike. Analysis of these coals indicates that they belong to the bituminous class. Their ash content is relatively low, 8-15 percent. The sulfur content ranges from 0.5 to 0.9 percent. These coals cake, as do PZh coals of the Donbass. Bituminous coals with analogous qualitative indexes are found also in the Into-Kozhimskiy region.

In other known deposits of the basin, the coal is lignite. Some of these deposits contain many coal seams and have large reserves. In the Adz'-vinskiy region, for example, 32 coal seams have been counted, five of which are up to 4.5 meters thick. The lignites contain 9-15 percent moisture, 16-35 percent ash, 45-60 percent volatile matter, and 0.6-2.5 percent sulfur. The calorific value of the coals is 4,300-5,500 kilocalories.

Lean, bituminous coal is encountered only in the eastern border of the basin, where the greatest thickness and disturbance of the sedimentary deposits occurs. Beyond the zone of lean coal to the west are located caking coals and still further to the west and southwest lignites.

Minusinsk Basin

The Minusinsk Basin is located in the southwestern part of eastern Siberia along the Yenisey River and its tributary, the Abakan. Administratively, the basin is a part of Khakasskaya Autonomous Oblast of Krasnoyarskiy Kray.

The coal resources of the kray began to attract attention only at the beginning of the 20th Century, but work for broad-scale exploitation of them was started only after the Great October Revolution. Khakasskaya, a forgotten and backward corner of Tsarist Russia, is becoming one of the industrial centers of eastern Siberia. The coal resources together with other mineral deposits are the basis for the development of industry here.

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From the geomorphological standpoint, the Minusinsk Basin is a syncline surrounded on all sides by mountain formations. To the west lies the Kuznetsk Alatau, separating the Minusinsk syncline from the Kuznetsk syncline. On the east and north are located the Vostochnyye Sayany; on the south the basin is bordered by the Zapadnyye Sayany. From these mountain formations the land of the Minusinsk Basin slopes down toward the center and takes on a cuplike shape. The surface of the syncline is more or less even, slightly cut by the river system and ravines. The level character of the surface is broken only in places by low crests.

Paleozoic deposits only are found in the geological structure of the Minusinsk Basin, being overlapped by deposits of the Quaternary Period.

Hydrogeological conditions of the Minusinsk Basin have been investigated so far only in general outline. Observations during mining operations have established that the coal-bearing strata are watery and primarily sandstone.

The first watery level is connected with the Beloyarskiy Series. The water-bearing elements here are fissured sandstones. It is clear that the water content of the rocks increases with increase in depth from 3-5 to 55-60 cubic meters per hours.

The second water-bearing level belongs to a layer of sandstone lying in the Bezugol'nyy Series. The third water-bearing level is connected with layers of sandstone lying below the Dvukharshinnyy seam.

In relation to coal-bearing properties, deposits of the Priyeniseysko-Abakanskaya Hollow have been better investigated than others, particularly those which have been discovered in an Abakan cross section. However, mining and drilling operations carried out widely in the past make it possible to speak of the coal-bearing properties of the Minusinsk Basin as a whole.

In the entire coal-bearing stratum of the basin, 63 coal seams have been uncovered, but only 22-23 have a working thickness (more than 0.5 meter). The distribution of seams and interlayers of coal according to series is shown in the table on the following page.

Name of Series	Thickness of Series (m)	No of Seams			Total Thickness (m)	Coefficient of Coal Content (%)	
		Total	Total Thickness (m)	Working		Total	Working
Konglomeratovyy	200	11	3.0	1	0.7	1.5	0.3
Chernogorskiy	350	32	17.9	11	12.0	5	3.4
Bazugol'nyy	140	2	--	--	--	--	--
Beloyarskiy	750	15	12.0	8	8.0	4.4	3.0
Narylkovski	725	3	over 10	2	9.87	1.1	1.1
	2,165	63	42.9	22	30.5	3.0	2.0

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Data in the above table show that the coal content of the Minusinsk Basin is relatively high. Principal working seams are concentrated in the Chernogorskiy and Beloyarskiy series; however, the coal seams of the Chernogorskiy Series have chief industrial significance. The thickest seams are in this series, except for one seam of the Narylkovski Series which is 9.87 meters thick.

The seams have an irregular thickness and complex structure; for example, the thickness of the Velikan seam ranges from 0.75 to 6.05 meters in the upper block and from 0.30 to 3.96 in the lower one. The thickness of the Moshchnyy seam ranges from 2.50 to 10 meters. The working seams are 1.0-4.5 meters thick on the average.

The coal seams often contain rocky interlayers of different thicknesses which divide the coal mass into layer-lentils. In this connection the following are characteristic: Giant seam consists of three coal lentils separated by layers of rock from a fraction of a meter to 3.5 meters thick. Velikan seam is divided into two lentils and Bezymyanny into two.

The principal coal seams of the Minusinsk Basin are a short distance from one another in a vertical direction, i.e., they are adjacent.

Minusinsk coals contain humic matter with a small admixture of sapropel. Outwardly they are rather hard, with a tarry-fat luster, and have a well-defined striatic structure because of the alternation of shiny, semishiny, semidull, and dull petrographic types. Shiny and semishiny varieties seem to predominate. Fusian coals are rather widespread in the make-up of Minusinsk coals, occurring not only in the form of seams but also as interlayers with a thickness of 10-15 centimeters. The percentage of fusian coals in some seams reaches 15-16 percent. Vitrain is encountered to a lesser degree.

In degree of maturity, these coals belong to the bituminous groups. Their volatile substance content amounts to 35-42 percent. On the basis of the percent yield of volatile matter, the coals belong to class G and, in part, to class D. In the Askyskiy deposit there is supposed to be PZh coal.

In connection with the complicated structure of the coal seams, their ash content range is 8-30 percent. However, the ash content of certain seams does not exceed 10 percent. An increase in ash content is noted with an increase in depth. This is explained by the predominance in the lower part of the seams and in the lowest seams of dull coal, which has a high ash content. The moisture content in the working fuel reaches 8.5 percent. Minusinsk coals have a low sulfur content, averaging 0.75 percent.

In distillation, Minusinsk coals yield a considerable amount of primary tar. The calorific value of the coals ranges from 7,000 to 7,800 kilocalories.

#### Tunguskiy Basin

The Tunguskiy Basin is located in eastern Siberia between the Yenisey River on the west and the Lena River on the east. Its territory covers the basins of the Verkhnyaya Tunguska, Srednyaya Tunguska, and Nizhnyaya Tunguska rivers, which are right tributaries of the Yenisey. The boundaries of the basin have not yet been precisely established. In the east the Tunguskiy Basin may join with the Lena River and they may make a southern boundary where the River Angara acquires a more or less latitudinal direction. In the north, the basin joins the Khatangskiy syncline, and the northern boundary is fixed conditionally along the southern border of the Khatangskiy Graben.

The Tunguskiy Basin is the largest coal basin in the world. Some explorers propose calling it Tunguskaya Coal Oblast. This proposal is motivated

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partly by the fact that the coal deposits are not in a continuous development as in other basins but lie in sections isolated from one another, representing, possibly, independent coal basins.

Administratively, the basin is under Krasnoyarskiy Kray. Coals were known to be in this basin even at the beginning of the second half of the 19th Century. However, the general dimensions of the basin were established by explorations undertaken after the October Revolution. The basin is still inadequately studied because existing industrial centers and railroads are remote and the population is sparse.

The coal-bearing properties are known only for certain areas of the basin. Thus, in the Angara area, 11 coal outcroppings have been established. In another part of the region, ten more outcroppings of bituminous coal were later discovered. Whether these seams are part of one or represent 21 coal seams, is not known.

The region most impregnated with coal is Nizhne-Tungusskiy. Of note here are the Bugarikhtinskiy, Noginskiy, Pelyatinskiy, Karaul'nyy, Anaki and other deposits, in which there are known to be five coal seams. The Anaki also has deposits of graphite. The seams are from 1.5 to 3 or more meters thick. The coal of this region is interesting in that it represents different groups of coalification from anthracites to type PZh. Of course, typically coking coals probably occur here.

The Noril'skiy region contains numerous deposits of coal and graphite. In these deposits are found three or four coal seams. The degree of coalification in the Noril'skiy region varies greatly. The volatile matter content in the seams varies from 5.41 to 23.1 percent.

There are a number of other coal regions in the southeast and eastern parts of the basin: Yerbogachenskiy, Chunskiy, Vilyuyskiy, and others, these are mostly unexplored.

The quality of the coal of the Tungusskiy Basin is extremely variable. Coals from lignite to anthracite are found here, and there are instances of conversion of coal into true graphite. Such a variety results in part from the heat of the magmatic rock entering into the coal stratum. Those sections of the seams are subject to graphitization which come into direct contact with the magma. The degree of change of the mass diminishes in proportion to the distance of the coal mass from the magmatic focus.

Some regularity is observed in the distribution of established groups of coal in the basin. Anthracite and graphites are located in the western part of the basin. They stretch out from south to north in a wide belt along the Yenisey River, from the Bakhta River to Noril'sk. In the central part of the basin in a southerly direction, there is bituminous coal with a considerable content of volatile matter, but in the east lignite is predominant. In going from east to west, regardless of the presence of traps, the content of volatile matter decreases. This is because in the eastern part the coal-bearing layers were formed in platform conditions and not sunk to a great depth. Therefore, the coalification of the coals is lowest here. In the central part of the basin there was a transition from platform to geosynclinal conditions which led to some increase in the degree of coalification. In the west, in the Priyeniseyskaya syncline nearly geosynclinal conditions were present. This is shown by the thickness of the coal-bearing layers and their lithographic content.

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Tunguskiy coals are humic, but a small amount of humic-sapropelites and pure sapropelites are also found.

Tunguskiy coals have a relatively low ash content, ranging in the Angara area from 7.20 to 22.9 percent, but coals with an ash content of less than 15 percent predominate. In the Nizhne-Tunguskiy region, the content ranges from 4.3 to 15.2 percent, and in Noril'sk from 7.25 to 18.4 percent.

The content of volatile matter for the basin varies from 4.6 to 58.9 percent, and the moisture content from 1-2 percent to 10-12 percent, but in lignites it reaches 20 percent. Tunguskiy coals usually contain not more than 1.5 percent sulfur.

Tests of coals of the Angara region for their coking properties indicated that they have satisfactory caking capacities. It is possible that coals suitable for the production of metallurgical coke may be found in the basin.

#### Irkutsk Basin

The Irkutsk Basin is located in eastern Siberia, west of Lake Baykal. Its coal deposits extend in a broad belt from the northwest to the southeast from the city of Nizhneudinsk to Lake Baykal along the Siberian Railway System.

Administratively, part of the territory of the basin in Irkutskaya Oblast and part in the Buryat-Mongolskaya ASSR.

When construction of the Siberian Railway System began, the Irkutsk Basin assumed importance in the coal balance of Russia, but it acquired its greatest significance during the years of the Soviet regime when a detailed study of the basin was begun. Operations in 1921 and 1922 showed that the Irkutsk Basin, in coal reserves, was not only one of the largest basins in Siberia but was also very important for quality and for variety of coal. The region has humic and sapropelic coals.

Morphologically, the basin is a hollow, between the Vostochnyye Sayany, the Priбайкальskie Mountains, and the low elevation of the southern part of the Siberian Platform. The surface of the basin is slopy-hilly, more broken up in the southwest than in the southeast. This is because traps have developed in the northwest of the basin, being gabbro-diabases and porphyritic diabases, occurring along fissures in the sedimentary layers or issuing at the surface in the form of lava deposits, very resistant to weathering processes and, consequently, forming elevations.

The contour has a typically eroded character caused by the flow of numerous small rivers. The main water artery here is the Angara River into which flow from the right and especially the left many tributaries which rise in the foothills of the Vostochnyye Sayany. The shallow rivers contain rapids, particularly where they cut magmatic rock.

The coal-bearing properties of the basin are irregular as a result of the process of agglomeration of the coal stratum and, in places, by the erosion of a considerable part of it. Some investigators assume that the agglomeration of the coal deposits was started in the southeast and then moved gradually to the northwest.

The Cheremkhovo level, with which that part of the basin with the main coal-bearing capacity is connected, is retained in most of the deposits. In Cheremkhovo itself, the main coal base of eastern Siberia, two coal seams are known: the lower one, Glavnyy, and the upper, Malyy. The seams are separated by a small interlayer of rock 2.5 meters thick.

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The Glavnny seam is 4.10 meters thick and is complicated in structure. The coal blocks are interstratified with layers of rock and bituminous shale. The seam has up to 20 interlayers of waste rock, the thickest of which divide the seam into three separate coal blocks which seem to be independent coal seams. The coal blocks and rock interlayers vary in thickness along the strike.

The Malyy seam plays a small role, with a thickness averaging 0.7 meter.

From the viewpoint of impregnation with coal, the Zabituy-Zalarinskiy Hollow deserves attention. This hollow contains the Zabituykiy, Golovinskiy, and Vladimirovskiy deposits. In the first, three seams of coal have been discovered: the bottom one is 3 meters thick; the central one, 2 meters; and the top seam has a slight and variable thickness. The coals are caking coals.

The Golovinskiy and Vladimirovskiy deposits are located in an area of slight dipping of the Zabituy-Zalarinskiy Hollow. Therefore the thickness of the coal-bearing stratum in them is slight. In these deposits four rather thick and sustained coal seams have been discovered.

The Tyert'-Ziminskiy region with numerous deposits of coal is of great interest.

In the southeast section of the Irkutsk Basin, a number of coal-bearing regions are important. Detailed study of them was begun only after the October Revolution.

In the Ust'Ordynskiy region, the wings of the folds seem to be industrially coal-bearing even though their axial stations contain only thin coal seams. The width of coal-bearing belts in slightly sloping wings is considerable; in steeply dipping wings it is much narrower. The seams are sustained along the strike for a distance of up to 10 kilometers but along the dip they are often broken and, in places, disappear. Such a phenomenon may be explained by the fact that the wings of the folds were sloping inclines of water reservoirs which, at the time of the coal agglomeration, existed in place of the present synclinal structures.

In the southeast part of the basin, the Barkhatovskiy deposit with one working seam (0.65-1.0 meter thick) and the Zhilkinskiy deposit with three coal seams (total thickness of about 2.5 meters) have some significance.

In the northwest part of the basin, the thickness of the coal-bearing deposits does not exceed 200 meters; nevertheless, there are rather considerable coal deposits here: Veletskiy, Tulunskiy, Shebartinskiy, and others.

In the Veletskiy deposit three coal seams have been established with a thickness of 2-4 meters. In the Tulunskiy deposit there are three seams with a total thickness of 6.8 meters. In the Shebartinskiy region there are five coal seams with a thickness of up to 4.9 meters.

Khakhareyskiy deposit located on the northwest border of the Irkutsk Basin seems somewhat isolated. Jurassic deposits here have a thickness of 30 meters of which the top 10 meters is coal-bearing. This 10-meter stratum has three seams, the top one of which is up to 4.5 meters thick. It consists of an interstratification of humic and typical sapropelic coals (Khakhareyskiy boghead).

The coals of the Irkutsk Basin vary greatly in qualitative indexes. In most cases they are humic coals but many of them are sapropelic coals. Sapropelic coals represent here typical boghead and unusual sapropelites. The latter is a shapeless sapropelic mass, characteristic varieties of which (for example, Khakhareyskiy and Mataganskiy bogheads) yield up to 93 percent of volatile matter.



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Humic coal components of all the main industrial deposits of the Irkutsk Basin are, in the main, lustrous varieties, in particular, clarain. Their degree of coalification is not high; nevertheless, in most cases they are bituminous coals with a volatile-matter content in the combustible mass of 43.6-50.4 percent and are referred to as classes G and D. In specific deposits, the presence of coals of type PZh has been established. Even gas coals of the Irkutsk Basin show good caking possibilities in places.

Despite the very complicated structure of the seams, the ash content of the coals is relatively low, ranging from 4.3 to 15 percent. The moisture content is 3-4 percent and sometimes rises to 11 percent. The sulfur content is not more than one percent except for some seams of the Zabituyskiy deposit, where it goes up to 4.4 percent.

#### Transbaykal Coal Deposits

In the Transbaykal territory are more than 40 small coal deposits, isolated from each other. They belong mostly to early or modern valleys of rivers. The coal-bearing deposits are conglomerates, coarse-grained sandstones, clayey shales, gravels, sands, and coal seams. They are 1,000 meters or more thick. On the basis of plant remains, found in the content of the coal seam, the seam is established as belonging to the Jurassic Period and in a lesser degree to the Cretaceous.

The coal deposits lie on an eroded and dislocated bed, made up of massive crystalline rock, predominantly of the pre-Cambrian Age. Coal deposits of the Transbaykal were formed in the lower part of rivers, in deltas, and in a lesser degree in stagnant water reservoirs. This confirmed by the combination of coarse-grained with fine-grained rock, and the presence of a large amount of conglomerates and coarse-grained sandstones.

The coal-bearing stratum is started everywhere with a thick layer of conglomerates and coarse-grained rock; above this are sandstones, and, in a small amount, clayey rock and seams of coal. The coal seams are found primarily in the top of the stratum.

The coal-bearing Jurassic or, in places, Cretaceous deposits are covered with deposits of the Tertiary and Quaternary periods.

The tectonics of the Transbaykal deposits of coal are closely connected with the early substructure and movements already taking place after the formation of the coal layers. In most cases, the coal deposits are trough-shaped shallow basins pressed between old rock. As a result of post-Jurassic and post-Cretaceous movements, the coal layers are concentrated in folds often asymmetrical, with a northeast—southwest direction.

The coal-bearing properties of the Transbaykal deposits vary. The coal seams vary from 1-3 to 20-25. Their thickness ranges from 0.3 to 4.5 meters and sometimes reaches 10-16 meters. The seams are not sustained in thickness: In places they are distended and in places they taper out, which gives evidence of the variable conditions of their accumulation.

Coals of the Transbaykal are mainly lignite; only in specific places (Bukachacha and Baingol'skiy) are they bituminous.

The deposits of Chernovskiy, Bukachacha, Tarbagatay, and Gusinozersk have been more or less studied and are at present being exploited.

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The Chernovskiy deposit is a part of the Ingoda Coal Basin located on the left bank of the Ingoda River. The coal-bearing deposits extend along the Ingoda River and are bounded on the northwest by the Yablonov Range, and on the southwest by the Cherskiy Range. The contour is not sharply broken up. Slightly dipping slopes alternate with the more or less level character of the surface.

On the eroded surface of the crystalline bed lies a series of basal conglomerates consisting of fragments of crystalline rock, pebbles, and sand. The series is 1,200 meters thick. Above it there follows a coalless stratum 400 meters thick, consisting primarily of sand with interlayers of bituminous shale (up to 40 layers).

The productive stratum lies parallel to the coalless stratum and consists of argillites, siltstones, sandstones, clayey shales, and seams and interlayers of coal. It is 165 meters thick. The lithographic content of the coal-bearing seams and the seams of coal is extremely irregular. The coal-bearing stratum of the Jurassic Period is covered with river pebbles of the Quaternary Period. The thickness of the detritus ranges from 2.5-3 meters to 35-40 meters.

The coal-bearing properties of the deposit are rather considerable. Nine coal seams have been established in the productive layer. Their thickness ranges from a fraction of a meter to 19 meters. Many seams of complicated structure have rock interlayers.

Chernovskiy coal is lignite with a volatile-matter content of 55.8 percent, an ash content of 4.8-16.8 percent, and a moisture content of 21.19-41.55 percent in the working fuel and 5.42-22.7 percent in the laboratory fuel. The calorific value of the fuel is 2,728-4,375 kilocalories.

The Bukachacha deposit is located in the broad part of the valley of the Bukachacha River, and is the old valley of a tributary of the Agita River, which flows into the Kuenga River. The territory of the deposit belongs in Chernyshevskiy Rayon of Chitinskaya Oblast.

The lay of the coal-bearing stratum is complicated by numerous faults with great displacements. Ten coal seams have been established in the coal-bearing stratum with a thickness from 0.3 to 11.95 meters but their thickness is not sustained; for example, the thickness of seam I varies from 0.57 meter to 11.44 meters; and seam II from 0.57 meter to 11.95 meters. The lower seams are thicker than the upper ones.

Bukachacha coal is bituminous. This is almost the only deposit which has typical bituminous coal with a volatile-matter content in the dry coal of 35-39.5 percent. Technically, they belong to classes G and PZh. The moisture content of laboratory fuel is 35.9-78.9 percent, and the ash content of the dry coal is 7.76-12.27 percent. There is less than one percent sulfur. The calorific value is 7,248-8,292 kilocalories. The coal shows good caking properties, but does not yield metallurgical coke independently.

The Tarbagatay deposit is located in the valley of the Khilok River between the railway stations Tarbagatay and Tolbaga of the Molotov Railway. The deposit fills the hollow, and is surrounded on all sides with outcroppings of granite and gneiss. The lithographic content of the coal-bearing stratum is sandstones, conglomerates, clayey shales, and coal seams. The thickness of the coal-bearing seam is fixed at 450 meters but in this stratum the sandy-clayey deposits, 64 meters thick, are the coal-bearing ones and four coal seams have been discovered in them, which in places merge to form one seam up to 18 meters thick.

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The coal deposits lie in an asymmetrical trough-shaped hollow extending northeast and contorted in folds. It is highly coalified lignite of the type of Chelyabinsk coals, but the quality is considerably higher than that of Chelyabinsk coals. The calorific value of the coal in the combustible mass is 6,450-7,415 kilocalories.

The Gusinozersk deposit is located within Buryat-Mongol ASSR in a wide hollow near Lake Gusinoe. Around the hollow lie granite and metamorphosed sedimentary rocks --crystalline shales. The hollow itself is filled with a thick stratum of sedimentary rock, consisting of sandy-clayey rock with coal seams and remains of plants characterizing the Upper Jurassic Period. The thickness of the sedimentary formations is 1,700 meters. In the lower part of the sedimentary rock lie conglomerates and sandstone with a thickness of about 700 meters. Over the sandy-conglomerate stratum lies the productive Jurassic stratum, 1,000 meters thick, in which up to 25 coal seams have been located. In the explored southeastern part of the deposit, the average thickness of the coal seams was 1.0-4.5 meters but one seam was 20 meters thick. The seams are predominantly of complicated structure, interlaid clays and clayey shales. The coal is lignite with an ash content of 11.6-18.7 percent and is liable to spontaneous combustion. Rather friable, it crumbles into fines.

In the productive Jurassic stratum lies a stratum of conglomerates with small interlayers of sandstones belonging to the Lower Cretaceous Period.

The Charanorskiy deposit is located between the Borzya and Khada-Bulak railway stations. The coal deposits are in the hollow between the Adun-Chilon and the Kukul'-bey ranges. First explorations established that the deposit consists of two coal seams separated by an interlayer of rock 14-16 meters thick. The thickness of the upper seam ranges from 10 to 17 meters and of the lower from 2.2 to 8.5 meters. Eight more coal seams have since been discovered.

The coal of the Kharanorskiy deposit is unusual. It looks like lignite but it consists of an accumulation of stems, leaves, and trunks, perforated (poburevshikh) and partly carbonized. The coal has a low ash content (3.40-4.50 percent) and contains much moisture (up to 28 percent). Its calorific value is 3,780-4,165 kilocalories.

#### Coal Deposits in Yakutskaya ASSR (Lena Basin)

Outcroppings of coal deposits have been established at many points in the Yakutskaya ASSR. At present, more than 100 deposits are known, located on the Lena River and its tributaries. It is assumed that these deposits primarily unite into one coal basin which, in size of coal-bearing area, is second to the Tunguskiy Basin. It is characteristic that all known deposits of the Lena Basin are of the Mesozoic Period. The coals in the basin of the Kolyma River and Chukotskiy National Okrug are known and exploited to a lesser degree.

In geological structure and shape of contour, the area of the Lena Basin may be divided into two parts, a western and an eastern section, the boundary of which goes approximately along the Lena River. The western part, on the left bank of the river, is within the bounds of the eastern borderland of the Siberian Platform and has a more or less level contour. The eastern part, on the right bank of the river, is located in the Verkhoyansk folded region and is mountainous. Accordingly, the deposits in the western part have platform features, but the deposits in the eastern part have geosynclinal features.

The Kangalaskiye deposit is located on the left bank of the Lena River. The coal-bearing deposits extend along the river for a distance of 30 kilometers.

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Often they are revealed in bank erosions. The total thickness of the deposits is 120-150 meters, they are subdivided into three levels: (1) the bottom level, consisting of sands 30-40 meters thick, (2) the central level of dark gray sands with clayey cement, 10-12 meters thick, and (3) the top sandy-conglomerate level, 50-60 meters thick.

Only the bottom level has industrial importance. Two coal seams have been established in it, the upper one about 2 meters thick and the lower one 3 meters. These are separated by a layer of clayey shales up to 3 meters thick. The thickness of the seams is not sustained. They have a lentil-like shape. The lay of the seam is regular. The coal is humic, lignite, and fairly pure. The ash content is up to 6.5 percent, the moisture content up to 19.5 percent, volatile-matter content in the combustible mass approximately 51.5 percent, and the calorific value about 5,000 kilocalories.

The Zhigansk deposit is located on the bank of the Lena River. Coal-bearing deposits have been discovered here for a distance of 45 kilometers along the river with a stratum thickness of 400-500 meters. Sands and sandstones predominate in the coal-bearing stratum, in which are found limestone deposits with plant remains. The stratum is concentrated in sloping folds with the angle of dip of the wings not more than 8 degrees.

The coal seams appear concentrated in the lower part of a cross section. Their number has not been established, but it is assumed that there are about ten working seams in the deposit. The coal is humic and lignite, with a moisture content of about 11 percent, ash 13 percent, and volatile matter 48.3 percent. The calorific value is 6,600-6,900 kilocalories.

The Bulunskiy deposit is vast, located on the lower reach of the Lena River. The thickness of the coal-bearing deposits is about 2-3 kilometers. Sandstones of even grain predominate. The entire stratum is subdivided into seven series, four of which are made up of sandstones and three of clayey rock and coal seams. The coal seams are concentrated in asymmetrical folds tilting in places to the west. The intensity of the folding increases toward the Verkhoyansk Mountains. Here the presence of about 40 layers of coal 0.10-1.67 meters thick has been established. They belong to the Upper Carboniferous series. The total thickness of the seams is 14-64 meters. The coal seams have a complicated structure and are sustained for a considerable distance. The quality of the coal is rather high. It is bituminous with a volatile-matter content of 32.8-53.3 percent and an ash content of up to 42.5 percent.

The Sangar deposit is located on the right bank of the Lena River, below the city of Yakutsk at the beginning of the foothills of the Verkhoyansk Range. Mesozoic sedimentary rock takes part in the structure of the area and its thickness reaches 1,350 meters. This stratum is divided into seven series, four of which are coal-bearing: the second, fourth, sixth, and seventh (from top to bottom). The coal-bearing seams are made up primarily of clayey shales and the intermediate ones of sandstones.

The coal-bearing stratum is gathered in folds, with the strike to the northwest. The angles of dip of the wings of the fold reach 40-50 degrees. The main structural unit is an anticlinal fold, the wings of which dip at different angles; its deposits in the center lie almost horizontal.

In the coal-bearing layer, 19-20 coal layers have been established, of which 4-6 seams have a working thickness. The thickness of individual seams reaches 2.1 meters. The total thickness of all the coal layers is approximately 18 meters but of the working seams it is 5-6 meters.

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Sangar coal is an intermediate between lignite and bituminous. It contains 46.1-56.6 percent volatile matter, 9.9 percent ash, and 4.8 percent moisture.

The Chechumskiy deposit is 25-30 kilometers from the Sangar deposit and is located in the foothills of the Verkhoyansk Range.

Mesozoic sedimentary rock plays the main part in the geological structure of the deposit, which conventionally belongs to the Jurassic Period. The known stratum of the Mesozoic deposit is divided into three series -- Sangar, Chechumskiy, and Baylyskiy (from top to bottom). The two top series are coal-bearing. The Sangar Series, 1,000 meters thick, is made up mainly of sandstone. Clayey rock is of secondary importance but to this belong the coal seams. The Chechumskiy Series, 920 meters thick, consists of sandstones and clayey rock with coal seams. The Baylyskiy Series, about 1,500 meters thick, is made up of coarse-grained sandstones, conglomerates, and rare interlayers of clayey shales. The coal-bearing deposits are contained only in the Chechumskiy series: In it have been ascertained 15 working seams from 0.9 to 1.5 meters thick. Coals of this series are bituminous with a volatile-matter content of 17.4-45.3 percent and an ash content of 12.9-33.2 percent. The calorific value of the coal is 8,046-8,575 kilocalories. These coals coke.

#### Coal Deposits of the Far East

The Far East USSR contains widespread coal deposits. They belong to different periods, starting with the upper Paleozoic and ending with the Cenozoic.

Anthracite seams are found in the Carboniferous deposits of the Suchanskiy Rayon. Coal seams occur in Permian deposits. However, industrial coal deposits in this part of the USSR are connected with Mesozoic and Tertiary deposits, and Jurassic and Lower Cretaceous deposits have the greatest impregnation with coal.

A peculiarity of coals of the Far East is their low geological age and their high chemical maturity. This is explained by the fact that the coal deposits are submerged to a considerable depth. Besides, they have been influenced by magmatic rock entering into the coal stratum, and the activity of tectonic phenomena which took place here in the Mesozoic and particularly in the Cenozoic period.

In the Far East, large coal deposits are unknown except for the Bureinskiy Basin and the coal basins of Sakhalin.

The Bureinskiy Basin is located on the upper part of the Bureya River in a hollow between the Bureinskiy Ridge on the east and the Turan Ridge on the west. The surface of the basin is cut by numerous tributaries of the Bereya River.

The first study of the basin was in 1932, in connection with the development of industry of the city of Komsomol'sk.

On the foundation of the coal-bearing stratum lie pre-Jurassic granites and metamorphic rocks. In these rocks lies a thick sedimentary stratum divided into two series-- the Bureinskiy and the Nikanskiy. In the foundation of the Bureinskiy Series (lower), are found conglomerates and coarse-grained sandstones. Above these follow sandy-clayey rocks with rare interlayers of conglomerates and with sea fauna of the lower and Middle Jurassic Period. These deposits are about 5,000 meters thick.

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Above lie the coal-bearing continental formations of the Nikanskiy series with a thickness of about 2,000 meters. This series has been determined to belong to the Upper Jurassic and Lower Cretaceous periods. The coal content of the Bureinskiy Basin is high but uneven. It is higher in the northern half of the basin. In the region of the Umal'ta River 30 coal layers have been discovered with a thickness of 0.15-3.5 meters. Nine to ten seams have a working thickness (a working thickness in the basin is taken to be 0.75 meter or more). In the region of the Urgal River, 13-17 coal seams of working thickness have been counted.

The seams of coal have a complicated structure and vary in thickness. The coals are bituminous, high-ash, and often difficult to clean. The volatile-matter content averages 30 percent. After cleaning they yield a well-caking and fusing coking residue. The ash content of the coal ranges from 10-15 to 40 percent. Coals in the southern region of the basin have an ash content of up to 40 percent. The moisture content of the coals ranges from 2-4 to 10 percent. The sulfur content does not exceed 0.54 percent.

The Suchan Basin is located on the southeast border of Primorskiy Kray. Possessing coals suitably diversified in quality, the Suchan Basin is one of the most important in southeast Primorskiy Kray.

The geological structure of the basin has been inadequately studied. As a result of work in recent years, the prolongation of coal deposits far to the north of previously known coal-bearing regions has been discovered, and here, as in the Donbass, there is a basis for speaking of a "Greater Suchan."

The tectonics of the Suchan Basin are complicated. The coal-bearing deposits are collected in folds broken by fissures and broken through by magmatic rocks. The main tectonic structure is an anticline with an almost latitudinal direction. The angles of dip of its wings reach 50-70 degrees.

Along with the large folds there are many small ones. In a northern direction the tectonics of the basin become smoother and the angle of dip of the rocks decreases to 15-20 degrees.

The coal content of the basin rises from south to north. The coal seams discovered have not yet been estimated and it is therefore hard to judge their total number.

Within the limits of the Suchan coal fields, 13 coal seams have been established ranging in thickness from 0.65 to 1.40 meters, of which seven seams with a total thickness of 6-9 meters have working importance. In the north, the number of seams reaches 22.

In the Suchan Basin are found coals from lignite to semianthracites and in the Carboniferous deposits there are also anthracites. The high degree of maturity of these coals is explained by contact, dislocational, and regional metamorphism. Bituminous coal predominates. The volatile-matter content of these coals ranges from 6-10 to 30 percent. The ash content is from 8 to 30 percent. Part of the coals yield coke of good quality.

#### Coal Deposits of Sakhalin

Mesozoic and Tertiary deposits on Sakhalin Island bear coal. The chief industrial coal deposits so far known here are in Tertiary deposits.

Cretaceous deposits lie haphazardly on the eroded surface of Paleozoic deposits and represent sea and continental phases. In the top part of the Cretaceous layer among the continental deposits, coal seams have been found.

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In the southern part of the island, Cretaceous deposits have scarcely been studied. In the northern part of the island, Cretaceous deposits start with the Orochenskiy Series, consisting of sandy-clayey rock with streaks of coal and plant residue, among which are found zones of marly shale with sea fauna. Above follows the part of the Cretaceous deposit containing the most coal -- the Gilyatskiy Series. It is made up of sandstones, clayey shales, and coal seams. The number of seams is large but has not yet been precisely established. As yet one can speak of their coal-bearing properties only for specific deposits; for example, in the Polovinka and Naynayskiy deposits there are known to be from three to ten seams. A chemical analysis indicates that the Cretaceous coals of Sakhalin are bituminous with a 30.47 percent yield of volatile matter, 1.18 percent moisture, 11.16 percent ash content, and 0.54 percent sulfur content. The calorific value of the coal is 6,944-7,000 kilocalories. Some seams yield coal suitable for coking.

Tertiary deposits are known best in the western part of north Sakhalin. On their foundation lies a basal conglomerate indicating a gap in the sedimentary accumulation between the Upper Cretaceous and the Tertiary deposits. On the conglomerates lies a thick layer consisting in the main of clayey and sandy shales, and to a lesser degree of sands and sandstones, and finishing at the top with clays. Coal seams are found among the clayey and sandy shales. The thickness of this stratum is about 4,500 meters. It is subdivided into six series (from bottom to top) -- Konglomeratovyy, Nizhneduykiy, Khandas (Gennoysha) Verkhneduykiy, Sertunayskiy, and Aleksandrovskiy series. The Nizhneduykiy and Verkhneduykiy are the coal-bearing series of this group.

The Nizhneduykiy Series, about 500-600 meters thick, is composed of sandy and clayey shales. In the top of a cross section are four coal seams.

The Verkhneduykiy Series, 1,000-1,200 meters thick, has a lithological content the same as in the Nizhneduykiy Series. Seven coal seams are known to be contained in it, but the actual number of seams in both series has not yet been precisely established. Although they are of the Tertiary Period, these coals are of relatively high coalification. The volatile-matter content in the combustible mass amounts to 22 percent, which permits supplying these coals for coking. In a northern direction, toward the Aleksandrovskiy Series, the degree of coalification lessens. Here is found coal of type D with a volatile-matter content of up to 45 percent. The coals have a low ash content.

In the territory of South Sakhalin, Tertiary coal deposits lie in haphazard fashion on Cretaceous sedimentary deposits and reach a thickness of 8,500 meters. According to paleontological signs, these deposits are on a parallel with the Tertiary deposits of northern Sakhalin.

In the lower part of the coal-bearing stratum sedimentary deposits stand out corresponding to the Nizhneduykiy series of northern Sakhalin. These as well as those in the north of the island are industrial coal-bearing series. In a cross section of this series of sedimentary deposits there are thick layers of conglomerates, various grained sandstones, and clayey shales. The thickness of the lower coal-bearing series amounts to about 1,000 meters.

The top coal-bearing series presents industrial interest in South Sakhalin which compares with the Verkhneduykiy Series of North Sakhalin. This series is composed of sandstones, shales, and coal seams. Its deposits are noted on both shores of the island. The greatest thickness of the series has been determined in Uglegorsk, where it is 1,500 meters thick.

The Tertiary deposits in the southern part of Sakhalin end with sandy-clayey deposits in which lignites have been discovered.

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In a tectonic relation, Sakhalin as a whole represents a large anticline with a southern extent. In the center of it there are Cretaceous deposits and, along the wings, Tertiary deposits. On both wings of this anticline, additional synclines and anticlines have developed which lie parallel to the main fold.

The additional folds are often asymmetrical. The angle of dip of the wings ranges from 10 to 80-90 degrees. Along with the folds there are many interrupted disturbances. They have a southern or nearly latitudinal spread. The southern disturbances have an amplitude of up to 100-300 meters, the latitudinal, 10-15 meters. The greatest dislocation of the sedimentary rock is observed in the central part of the island on the western shore. Magmatic rock entering into the sedimentary layer complicates the tectonics of the coal deposits here. The complicated folding and interrupted disturbances make some deposits unsuitable for working.

The coal-bearing properties of the southern part of Sakhalin, just as in the north, are connected with Cretaceous deposits and the Tertiary Period, but the Cretaceous coal content is unknown. The productive series of the Tertiary deposits contain 37 seams of coal with a total thickness of about 80 meters, of which 24 seams, with a total thickness of 49 meters, are working seams. The coefficient of coal content is 2.7 percent. Coal seams are sustained for an extent of 6-8 kilometers. All seams more than one meter thick have a complicated structure. Seams 0.7 meter thick or more are working seams. Most seams are 1.2-1.5 meters thick, more rarely up to 10 meters, and as an exception up to 15-17 meters. The coal seams are primarily adjacent. Some regularity is observed in the spread of coal seams: In the lower part of the coal-bearing deposits, the coal content increases from south to north, but the coal content of the upper series increases in the opposite direction, from north to south.

Sakhalin coal varies greatly in quality. Here one finds lignite, bituminous coal, and anthracite. Predominating are coals of types G and D, transitional coals from lignite to bituminous coals. The volatile-matter content of Sakhalin coals ranges from 13 to 50 percent. The ash content ranges from 5-6 percent to 18-20 percent, but some seams have such a high ash content that they are not worked. The sulfur content of Sakhalin coal is 0.15-0.63 percent and the moisture content 8.32-12.77 percent. The composition of these coals corresponds to lignite and bituminous coal. The calorific value of the coals ranges from 5,625 to 8,500 calories. The specific gravity of the coal is 1.35. When distilled, Sakhalin coals yield very little tar (up to 6.4 percent).

In the northern part of the island, no lignite has been discovered, but in the south lignite predominates over bituminous coal.

Basic tasks in the study of the coal content of the island of Sakhalin are the search for and exploration of the large supplies of coking coal and cokable coal, and exploration of the Cretaceous coal content. In several places in north Sakhalin, coal of the Cretaceous Period is typically coking coal.

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